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PATENT APPLICATION

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Title of the Invention: SAMPLE ABSORPTION CURRENT IMAGE OBSERVATION METHOD

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SPECIFICATION

Title of the Invention

SAMPLE ABSORPTION CURRENT IMAGE OBSERVATION METHOD

Claims

A sample absorption current image observation device constructed from a primary electron beam column which has the function of focusing* and scanning a primary electron beam on the sample surface, an image display device which makes it possible to obtain a sample absorption current image by performing a brightness display of the charged electron current that flows into the sample on a cathode ray tube in synchronization with the scanning of the primary electron beam on the sample surface, and an ion gun which is used to strip the sample surface by means of an ion beam, this observation method being characterized by the fact that a sample absorption current image is obtained while scanning [the sample surface] with the primary electron beam focused on the sample surface, and at the same time stripping this sample surface with the ion beam.

Detailed Description of the Invention

The present invention relates to an observation method for obtaining a sample absorption current image while stripping the sample surface with an ion beam.

With the recent increase in the demand for observation of microscopic parts of solid surfaces of ICs, etc., electron microprobe surface analysis has attracted attention. For example, in the Auger electronic analysis method using an electron microprobe, a sample absorption current image is utilized as a monitor of location selection in the point analysis of the Auger electronic analysis. Furthermore, since there is a conspicuous dependence on surface conditions, there are possibilities for using [this method] as an independent surface microscopic method.

When a solid surface is irradiated with an electron beam (primary electron beam), the phenomenon of secondary electron emission occurs in which other electrons (secondary electrons) are emitted from the same solid surface. The ratio (I_2/I_1) of the electron current I_2 combining the secondary electrons and the electrons emitted from the solid surface via the process of elastic or inelastic scattering of the primary electron beam to the primary electron current I_1 is designated as δ. δ shows a conspicuous dependence on the element(s) of the solid

* Translator's note: here and elsewhere, the Japanese source text literally reads "converging," but "focusing" seems to be intended. The term "focus" is used throughout this translation where the Japanese original literally says "converge."

surface, the geometrical shape of the solid surface and surface conditions such as the crystal structure of the surface. Accordingly, by showing a brightness display of the electron current that flows into the solid sample on a cathode ray tube in synchronization with the scanning of the solid sample surface by the primary electron beam, it is possible to obtain a sample absorption current image based on differences in δ in the solid surface scanning region of the primary electron beam.

Furthermore, the ion etching method, in which atoms of a solid sample surface are knocked out by irradiating this sample surface with an ion beam so that the sample surface is stripped, is widely used in the field of solid surface technology as a means of solid surface cleaning and interface analysis, etc.

The present invention is characterized by the fact that a sample surface is irradiated with an ion beam at the same time that this sample surface is scanned with a primary electron beam, so that the surface conditions resulting from the stripping of the same sample surface can be dynamically observed by means of a sample absorption current image.

Details of the invention will be described below on the basis of an embodiment.

The figure is an explanatory diagram which shows one embodiment of the present invention; this figure shows the primary electron beam column, the construction of the ion gun and the sample absorption current image recording system. In Figure 1 [*sic*], 1 indicates a primary electron beam source, 2 indicates a Wehnelt electrode used for the focusing of the primary electron beam, 3 and 4 indicate magnetic field lenses used for the focusing of the primary electron beam, 5 indicates a deflection coil which scans the primary electron beam in one direction over the sample surface, 6 indicates a deflection coil which scans the primary electron beam over the sample surface in a direction perpendicular to the scanning direction of the coil 5, 7 shows lines that indicate the direction of the primary electron beam, 8 indicates a sample, 9 indicates an ion gun, 10 shows lines indicating the direction of the ion beam, 11 indicates an electrical circuit which converts a current ($I_1 - I_2$) that reflects the difference in δ in the charged electron current that flows into the sample into the brightness-modulated signal of a cathode ray tube, and 12 indicates a cathode ray tube.

The region on the solid sample surface that is scanned by the primary electron beam is irradiated by a direct-current ion beam generated by the ion gun 9, so that the same sample surface is stripped. Accordingly, the charged electron current that flows into the same sample is the sum of electron currents ($I_1 - I_2$) that reflect the difference in δ in the scanning region of the primary electron beam and constant ion current. A sample absorption current image can be

obtained by cutting the direct-current component of the charged electron current that flows into the sample and converting the fluctuating component into a brightness-modulated signal of the cathode ray tube 12 (in synchronization with the scanning of the solid surface by the primary electron beam) by means of the electrical circuit 11. If the diameter of the ion beam is set smaller than the primary electron beam scanning region in a sample absorption current image obtained under the same conditions, the surface conditions in portions where stripping has progressed and portions where stripping has not progressed can be dynamically observed. Conversely, if the diameter of the ion beam is set sufficiently larger than the primary electron beam scanning region, the surface conditions at a fixed depth from the solid surface can be dynamically observed.

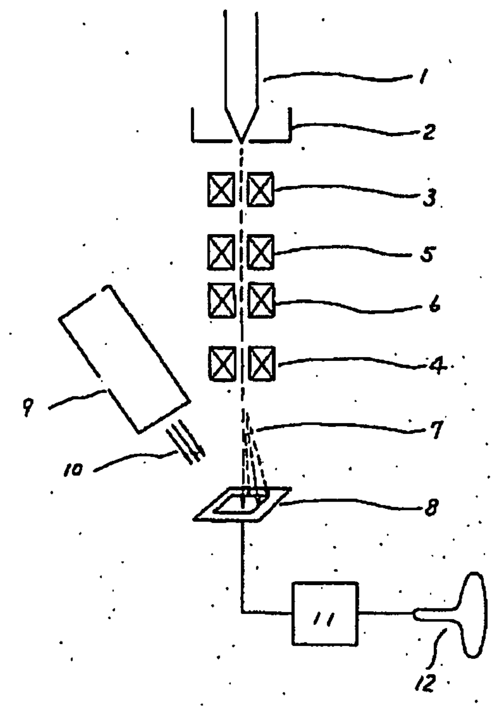
It has been confirmed by experiments conducted by the inventors that the sample absorption current image also varies conspicuously with the degree of adsorption of a monatomic layer of carbon, so that if such a sample absorption current image is observed while the sample surface is irradiated with an ion beam by means of an ion gun with a slow stripping speed [of the type] used in the Auger electronic analysis method, dynamic changes in the surface conditions of the same sample surface can be ascertained in detail.

Furthermore, in Auger electronic analysis, the selection of locations is performed using a sample absorption current image; in the present invention, the selection of locations can be performed while irradiating the sample surface with an ion beam.

Brief Description of the Drawings

The figure is a diagram which shows the construction of the apparatus used in the present invention, and the recording system [used] for the sample absorption current image.

1: Primary electron beam source; 2: Wehnelt electrode; 3, 4: Magnetic field lenses used for the focusing of the primary electron beam; 5, 6: Deflection coils; 7: Lines indicating the emission of the primary electron beam; 8: Sample; 9: Ion gun; 10: Lines indicating the direction of the ion beam; 11: Electrical circuit; 12: Cathode ray tube.



List of Appended Documents

(1) Specification:	1 copy
(2) Drawings:	1 copy
(3) Power of Attorney:	1 copy
(4) Duplicate of Patent Application:	1 copy

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